

# **SMART DOOR LOCK BASED ON BLUETOOTH AND IoT**

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## DECLARATION

For my beloved father, mother, brothers, family

for IRAQ

For my supervisor **DR ZUHAIRIAH BINTI ZAINAL ABIDIN**



## ACKNOWLEDGEMENT

I would like to thank my supervisor, Dr. ZUHAIIRIAH BINTI ZAINAL ABIDIN, for the patient guidance, encouragement and advice that she has provided throughout my time as his student. I have been extremely lucky to have a supervisor who cared so much about my work, and who responded to my questions and queries so promptly.

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Nobody has been more important to me in the pursuit of this project than the members of my family. I would like to thank them, whose love and guidance are with me in whatever I pursue. They are the ultimate role models for me.



## ABSTRACT

Numerous control systems for home security purposes have been designed over the years to prevent access to the unauthorized user. The main aim of the control systems is for providing a security for our lives and property for home, schools, offices etc. Therefore, it is important to have a smart technology of achieving this goal. Automatic door system has become a standard feature on many different types of buildings and homes. Further, they are becoming popular due to an effective electronic device which provides high security. Home security has been a major issue because of the increase in crime rate and everybody wants to take proper action to prevent unauthorized users. There was a necessity to automate home so that user can take advantage of the IoT technology as well. Therefore, this project is to develop a prototype of a door security code system using smart device Bluetooth as a key and interface with the IoT in order to monitoring the system. This project was successful working and thus, this design can be a good candidate for home security applications.

## ABSTRAK

Sejak beberapa tahun, terdapat pelbagai sistem kawalan untuk tujuan keselamatan rumah telah direka untuk mengelakkan di akses oleh pengguna yang tidak dibenarkan. Matlamat utama sistem kawalan adalah untuk menyediakan keselamatan untuk kehidupan dan harta benda untuk rumah, sekolah, pejabat dan lain-lain. Oleh itu, adalah penting untuk mempunyai teknologi pintar untuk mencapai matlamat ini. Sistem pintu automatik telah menjadi ciri piawai pada pelbagai jenis bangunan dan rumah. Tambahan, sistem ini menjadi popular kerana mempunyai peranti elektronik yang berkesan yang memberikan keselamatan tinggi. Keselamatan rumah menjadi isu utama kerana kenaikan kadar jenayah dan semua orang mahu mengambil tindakan sewajarnya untuk menghalang pengguna yang tidak dibenarkan. Terdapat juga keperluan untuk mengautomasikan rumah dengan memanfaatkan teknologi IoT. Oleh itu, projek ini dijalankan untuk membangun prototaip sistem kod keselamatan pintu menggunakan peranti pintar Bluetooth sebagai kunci dan teknologi IoT digunakan sebagai antara muka untuk memantau sistem. Projek ini berjaya dilaksanakan dan oleh itu, reka bentuk ini boleh menjadi calon yang baik untuk aplikasi keselamatan rumah.

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PERPUSTAKAAN TUNKU TUN AMINAH

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## LIST OF ABBREVIATIONS

<i>IoT</i>	-	Internet of things
<i>SDL</i>	-	Smart Door Lock
OTP	-	One Time Password
MAC	-	Media Access Control
JSON	-	JavaScript Object Notation
SDK		Software Development Kit



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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background Study**

The Internet of Things (IoT) can be described as connecting everyday objects like smart-phones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Building IoT has advanced significantly in the last couple of years since it has added a new dimension to the world of information and communication technologies. Automatic door system has become a standard feature on many different types of buildings and homes. And they are becoming popular every day to develop an effective electronic device which provides security. Home security has been a major issue because of the increase in crime rate and everybody wants to take proper action to prevent unauthorized user. There was a necessity to automate home so that user can take advantage of the IOT technology. IoT security is of utmost importance as the aftermath of security breaches in IoT can be devastating. A breach in a smart car or smart door lock could lead to stolen products or even casualties in some extreme cases.

#### **1.2 Problem Statement**

The world nowadays look like is not safe place after all home security system is needed to discourage intruder and burglars. Installing home security is very important that might be a way that can give us the peace of mind that we all deserve. Home security system is just the perfect way to us to increase our overall sense of safety. Nowadays

that is so many type of security at the market such as biometric fingerprint security, face detection security, dynamic signature and many more. Hand free key door technologies are an alternative way to open the door if we loosing key because there is no key and the system depend on the mobile phone to become the key because mobile phone becomes one of the Essential in people life and been carried and never forgotten. The security aspect is the highest concern of IoT connected entities. The data can be personal, enterprise or consumer [1]. To reach an acceptable implementation for the smart door lock (SDL), security should be taken as a major challenge. This research addresses the problem of setting up high and strong authentication between the user point entity (e.g Smartphone) and the API to generate an access token for the user that has privilege to unlock the door as well as provide strong privacy guarantees. To accomplish this goal, we need to decide on effective connection protocols can be used in the product and offers the ability to authenticate, and access control, testify the local WiFi network fulfil the security obligation, select the efficient microcontroller which satisfy the aims of the product by offering a secure IoT system and design and implement IoT architecture that can fit the aim of Smart door lock [3][4].

### **1.3 Objectives**

The purpose of this research project is to study and evaluate a suitable set to develop a smart door lock which is intended to offer high security, easy access, and control through constructing IoT system that includes the Smart Door Lock application. The specific research objectives are:

- 1- Construct functional and secured system architecture.
- 2- Using Bluetooth to determine if a user is in the physical proximity of the door lock and authenticate users trying to access the door.
- 3- Develop an android and iOS application to serve as the user endpoint.

### **1.4 Scope of Study**

The geographic scope of this research is limited to a personal property (house, apartment and office). The design and execution scope of this research is confined to

designing and building a comprehensive, low-cost home control system using a mobile application that communicates with the Raspberry Pi mini-computer through the Bluetooth. Java and/or Python programming languages are used to install an operating system on the Raspberry Pi mini-computer to enable running specific applications. Further, the research seeks to assemble an electronic board that contains circuits which is responsible for a certain function in the door control system, and each of which communicates with the Raspberry Pi. The access system using smart hand free door lock can be developed after a method to interface between App, microcontroller and database must be done first. To make it realistic, smart phone can be scanned using Bluetooth. Then, some database can be used to perform comparison between user smart phone data and data store from the admin. If the user is not in the database he/she have to press the door ball, image of the user will be visible to admin in App to decide whether to open the door or not, the output from the microcontroller will be represents of magnetic lock, door ball and IP camera which will be control and monitor from android app in final step.

### **1.5 Significant of study**

Home control system has witnessed a widespread interest and great enthusiasm that surrounds home systems today. Many people are looking for ways to make their daily, repetitive tasks at home easier, simpler, less exhausting, and even more fun. Our project offers a comforting, seamless, and modern solution to every day annoyances. We can't continue to live in the past when we have the technology and the ability to live in the present, a present that allows us to project ourselves into a future brimming with ease and comfort. The prototype being developed in this thesis is intended to offer high security and easy access control. The development phase will rather focus on delivering a prototype that is well-protected against malicious attacks than extensive user functionality. This can lead to a product that has high security. However, it would need some further development and optimization to fit the purpose of a user-friendly product.



## 1.6 Thesis Outline

This master thesis is divided into six chapters.

**Chapter one** present the background and contextual view of conducting this research on the use of IoT to create a smart door lock. Chapter one also presents the problem statement and research objectives. Further, the research scope, significance and thesis outline are identified.

**Chapter two** provides a review and synthesis of academic literature on various types and the use of IoT in creating Smart Door Lock systems.

**Chapter three** introduces the research methodology employed in this dissertation and explains the system setup.

**Chapter four** presents the technical information on designing the system architecture and the implementation of the proposed Smart Door Lock prototype.

**Chapter five** Conclusion on executing and testing of the prototype.

## 1.7 Summary

This chapter has laid the foundation of the current study. It has presented a brief background of IoT and Smart Door Lock systems. Additionally, research objectives and stating research problem were introduced. Further, the scope and significance of research along with organization of this thesis were explained.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 History of door lock

In our daily life, there is no common door lock device. In fact, the history of machine safety lock doors dates back to thousands of years. The progress of the door locking mechanism is interesting. However, recognition of criminal regulations such as regional locks, cultural influences that can be carried, and reliance on social and religious practices, to prevent its design, and access from others, it has the right to control others and restrict access to the area [5]. Unlike other safety barriers, locks are unlocked from the point of view of the intended owner of the key, this also suggests that "locks provide a means to control based on the concept of appropriate permission or authorization access" It is [6]. In the ancient world, as a symbol of the status and power of [7] it was also an understanding of the holder key's social identity. We conclude that pace (2014.108), "This material is just beyond the physical barriers in the old world, but it also serves as a means to transfer social and cultural identifiers and personal wealth and wealth "On the other hand, rock is" a lot of permission technology to exclude technology, one of the details became the key to mechanical locks, not just Adept.

In general, the origin of locks and keys, and their mechanisms remains ubiquitous. Although the archaeological evidence for early locks remains small, many books, book chapters and articles have been written during the last two centuries [6]. Historically, from the beginning all locking mechanisms and keys were completely made of hard wood and strictly avoiding curves, especially those that appear in Mesopotamia and Egypt. It seems that, wooden-key types arose early in most diverse cultures that relied

upon wood as a basic material, and so far as for their main tools. The wooden locking devices were of grand implication; they were noticeably similar in their operational and functional approach. Actually, various specimens of the wooden-key types survived at many traditional door houses and structures in over large parts of the world, especially in the Mediterranean region. On the other hand, it is not so easy to confirm who inspired whom, in terms of door locking cultural influences, or whether the similarity can be seen as a case of analogous solutions to a common problem or need to all mankind. It seems that, the first simple devices of wooden locks and keys, were probably invented by many early civilizations at the same time. Generally, we can assume that cords and ropes were used to fasten doors, and the legend goes, a knotted cord became a common symbol of security in different early cultures. According to Curtis and Ponting [7] locks and keys made from bronze and iron were utilized after the Chalcolithic epoch.

The advanced digital technology, however, has changed the role and manufacture of locking mechanism and keys to the point that, small plastic pieces, digital numbers and codes, within the computer chip inside "acts more effectively than a lock made from a hunk of metal with a key to open it [8]. In theory as also in practice, any mechanical lock that is operated with a key can be picked [9]. Meanwhile all locks could be picked, Linus Yale clarified that there is an ultimate danger for any lock based on a key and keyhole to be picked, though the solution is using no key at all [10].

## **2.2 Type of Automatic Door Lock**

Security systems of Door lock can be classified according to technology used as:

### **2.2.1 Password Based Systems**

The programmable electronic locking device [11] is programmed to operate only with a predefined number of correct inputs. Lock type is also called integrated compatibility. The programmable lock icon is displayed as shown in Figure 2.1.

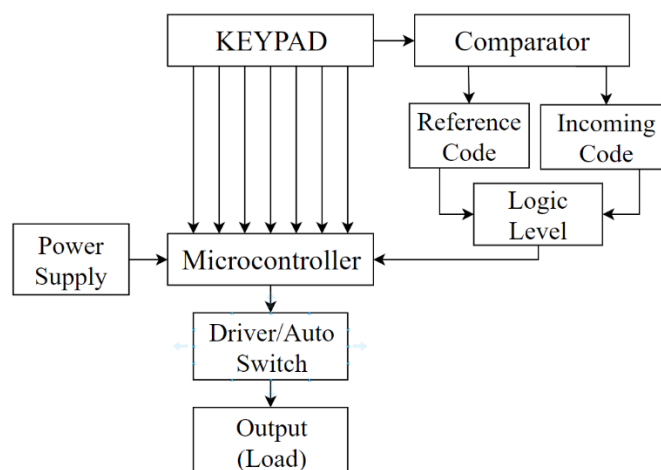


Figure 2.1: Programmable Electronic Code Lock [11]

The programmable electronic code locking device [11] is programmed to operate only with the correct input of predefined numbers. This is also called a built-in combination lock. Figure 2.1 shows the programmable code lock.

An electronic safe is one example. Based on a programmable electronic code lock, the reprogrammable digital door lock [12] is invented in that the password may be changed at any time when stored in the PROM. You can operate the device using the GSM / CDMA module. When someone receives a call from the phone, that phone is received by the system. Also, the door opens only for calls from specific users.

As shown in Figure 2.2, the password locked cell phone door lock system, as shown in Figure 2.2, allows you to open the door with the help of a mobile phone device by entering a specific code. It was proposed. The user can call the system number. This call uses the correct password to open and close entries.

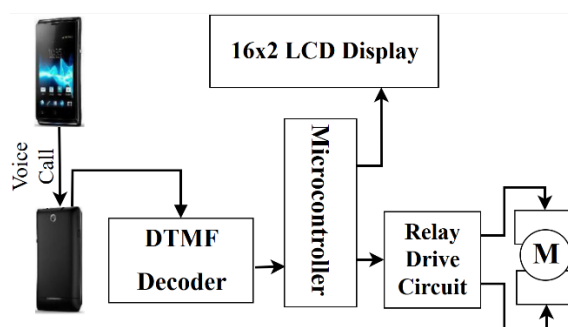


Fig 2.2: Password Protected Door Locking System based on Cell Phone [12]

In modern password-based systems, a more sophisticated system [14] evolving when an unauthorized person tries to open the code by giving the correct code, connects to the owner of the office or home. When closing the office / house door, the owner needs

to leave the system by pressing the "available" 0 key on the hexadecimal keypad. The system developed by Annie P. Oommen et al. Is God. [15] Change the password. In order to open the lock, the entered password must match the changed password. In some systems, an unauthorized person enters an invalid password and when the controller informs the owner via the GSM modem, it can make a secure dialing via the GSM modem [16]. The latest protection system is designed to be able to enhance RF and GSM RF protection security system with 4 digit password to provide authentication [22].

### **2.2.2 Biometric Based System**

Palmtop recognition is the next step to identify fingerprints [17]. It works with palm images. First, the system takes a palmtop, processes the image by dividing it, and requires processing. Finally, please check the appropriate person. Therefore, it reduces the possibility of errors in other people's recognition method and explains problems encountered in fingerprint recognition. Biometric technology is very convenient in bank safe. In the bank security system, the microcontroller continuously monitors the vein detector and scans with the keyboard authentication code. At night, when the wireless motion detector becomes active and changes in output occur, it will be detected by the console and warned.

Recently, existing basic component analysis methods, in which basic component analysis methods of face recognition and face detection [19] are being changed, have been rapidly proposed. The image is captured by the webcam and matches the image stored in the database. Based on the human iris pattern an advanced door lock safety system is provided to provide advanced security. To make the system more efficient and reliable, simulation is performed in MATLAB [20].

### **2.2.3 GSM Based System**

Many of the door lock safety systems are used for the purpose of GSM communication. By using circuits such as GSM units activated by a controller [21] that sends an interview for security services on intrusion in order to send an SMS in case of an emergency to the owner, the purpose of the porting work. To detect obstacles, the

system needs different sensors. Collect data from sensor and snap on selection. With the help of GSM, it sends SMS messages to their respective numbers. Models recently created for security doors [22] GSM devices can be easily controlled as remote control operation, senders and encryption disjunct DTMF, using a stepper unit microcontroller, can be mounted on the engine mounting door Works as a range of other GSM mobile phones with DTMF associated with.

Currently, people want to be secure even when they are a way home so, the work proposed by Jayashri Bangali. [23]. security of home is important things and it is the big issue in front of all. Two frameworks were created which depends on GSM-based technology. For detection of the gate-crashers, it takes place by capturing an image through a web camera. When peoples are not at their homes, the system sends notification in terms of SMS to the crisis number. A novel administrator based system [25] can log in without any stretch to the system and can see guests record and listen their recorded messages and also automatically lock the door using mobile communication technology.

#### **2.2.4 Smart Card Based System**

The security framework aims to authorize those who are authorized to access a secure entrance (without the need for a key) where the smart RFID card is valid to ensure passage of the door. The overall control activity is performed by the microcontroller.

#### **2.2.5 RFID Based Systems**

These kinds of security systems used for digital door lock [26] utilize inactive RFID tags (passive). This will allow only correct people to enter. Such system is performing real time fundamental work for opening a door where a user has to bring a tag into contact with the RFID detector, the entrance opens and the registration data is stored in the user's necessary database. These type of systems can be used for person tracking and Attendance. An RFID-based gate access security system that points out authorized people and allows them has been effectively created by K. Srinivasa et al. al. [27]. This type of system should have the ability to minimize trained or special human errors during secure door access.

The arduino platform can be used for RFID-based door lock security system [28] with cards being placed close to the RFID module, the system will check card data with the data stored in the memory for matches to tell if the person is authorizing or unauthorized entry. Arduino is also used in many other applications. For example, certain Arduino ATMEL processors can be used for human perception and recognition. [29] also ECG parameter identification and monitoring [30].

### **2.2.6 Door Phone Based System**

Early systems are specific systems where the visitor's identification is made mostly by communicating directly with the relevant set of residential properties [31]. Dial up to the set via hands-free phone is created by the entrance framework. Visitors enter the interior via the gate by controlling the gate with the help of the phone. The latest system that was Chau-Huang Wei et al. al. [32] is built on video door phone scrutiny which it is uses to identify the guests. This work utilized a new power line communication chip to build a digital network video door phone. In addition, they exchanged audiovisual information and improved the aisle protection ability

### **2.2.7 Bluetooth Based Systems**

The Bluetooth based system is like a questionnaire survey using the Bluetooth function [33] available on smart devices. You can see that the framework using Bluetooth is simpler and more productive for proper use. Arduino platform are generally used in this system. The hardware of such a framework is a combination of smartphone and Bluetooth module. Here the Arduino microcontroller acts as a controller and the solenoid can operate as the output of the locking system.

### **2.2.8 Social Networking Sites Based Systems**

In a concrete study [34], we achieved digitization and safety from the standpoint of using a telephone and a web camera. This model makes it possible to close and open doors from assigned areas using SMS from (Facebook, WhatsApp etc).



Lately, a new digital door lock system [35] that detects visitor unknown body contacts is designed and instantly notifies the owner via the smartphone as shown in Figure 2.3. At this time, if an incorrect password is detected beyond the specified time, the system catches the photo of the unknown visitor and sends it to the owner via the smart device. In this way, the strength of the security function increases.

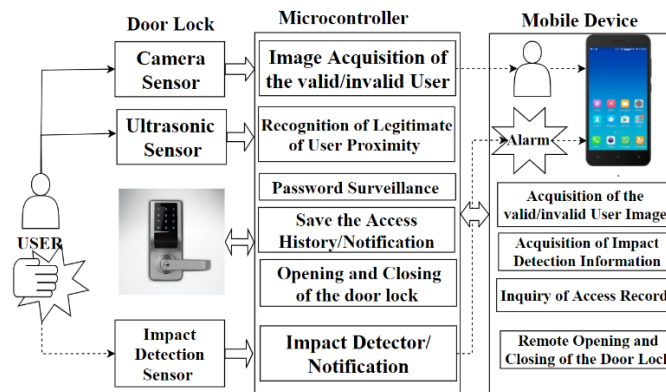


Figure 2.3: Digital Door Lock model based on Internet of Things [35]

With the help of advanced technology, the intelligent door system using the internet of things that been demonstrated by S. Nazeem Basha et. al. [36]. The system provides warning of intrusion by sending a notification e-mail to the home/workplace owner. Record all intrusion data in the owner Google Drive account (Google spreadsheet). The ADXL345 accelerometer detects the movement of the door, the raspberry pi reads the sensor intrusion data and communicates with the Amazon Web Services Internet of Things (AWS IoT). Like Arduino, the Raspberry Pi module is an inexpensive computer, mostly using a Linux-based operating system [37]. It also has an open source platform for using devices such as 10/100 Ethernet, USB, GPIO, HDMI port etc. It also has slots for SD cards that can store Linux raspberry packages [38]. It has a great range in research and development in the field of smart door locking systems.

### 2.2.9 One Time Password Based Systems (OTP)

If the user knows the One Time password technology and has a registered mobile phone, the method proposed in the latest work does not require administrator's help to access the facility. Similarly, the One Time password Based is produced and sent to the registered user phone each time the user requests access to the facility. The One Time password should go through the door keypad. [40], the door opens. If the cell



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